



NASA Marshall Space Flight Center

Undergraduate Student Research Program (USRP)

Intern Presentations Spring 2010

Wednesday, April 28, 2010
Bldg. 4205, Room 112E/F

GFSSP IN ER-43

Keon Hawthorne

About the Presenter

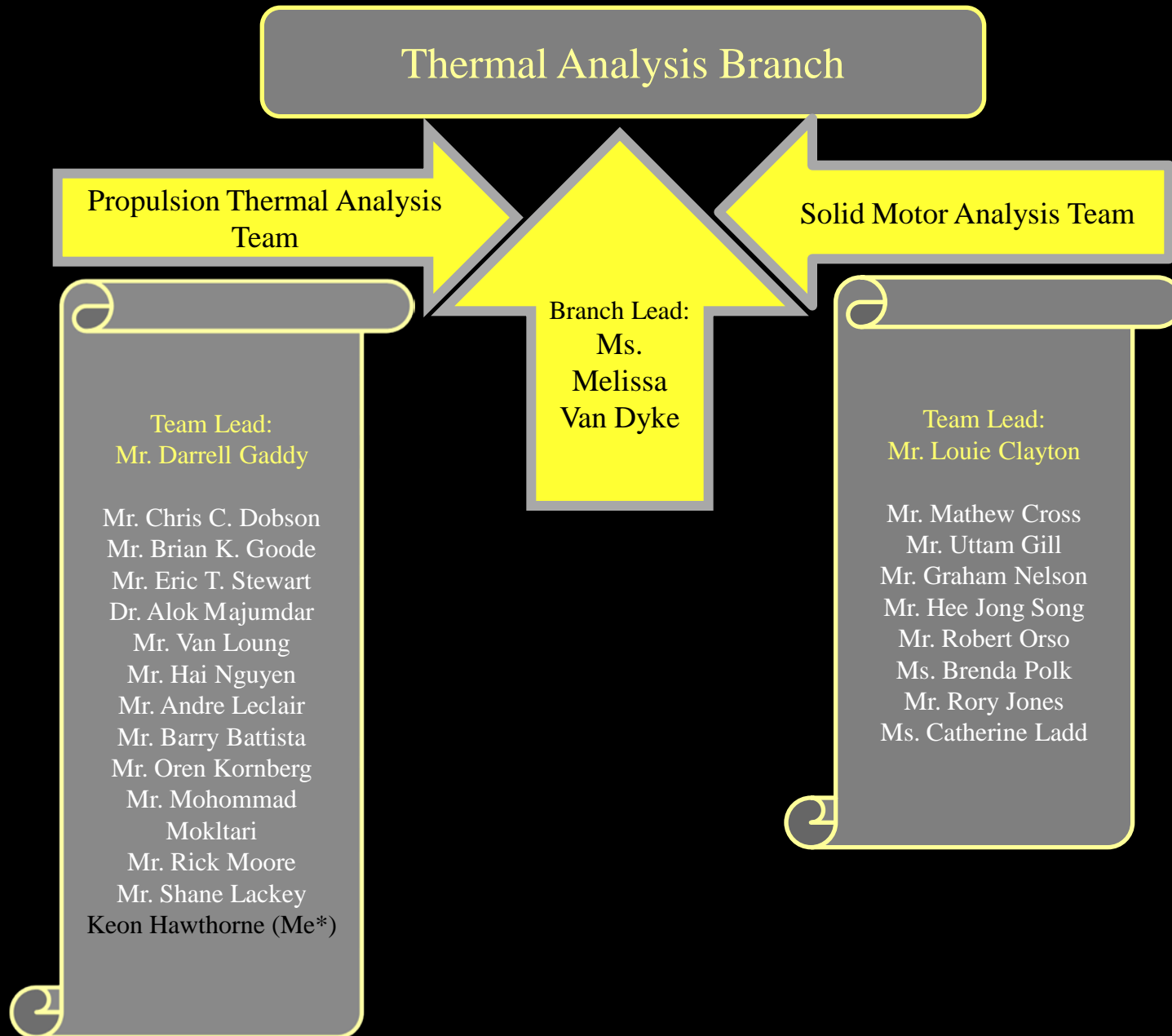
- From Memphis
- Attend Alabama A&M University
- Fitness & Sports Enthusiast
- Noted for my apparel choice



Agenda

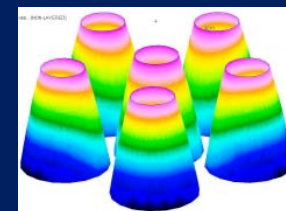
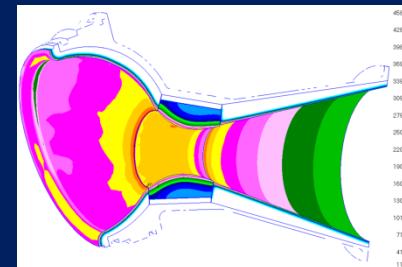
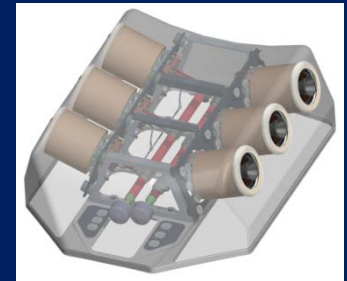
- Introduction to ER-43
- Overview of GFFSP
- Validation of GFSSP
- Additional Assignments and tasks
- Valuable experience received

ER-43



ER-43 Projects

- Shuttle SSME Operations
- Shuttle RSRB Operations
- Shuttle External Tank Production
- Shuttle PSE&I – MPS
- Ares First Stage Booster - RSRMV and BDM/BTM
- Ares 1-X First Stage Booster
- Ares -J2-X
 - Engine Systems Hardware
 - Systems Engineering
 - Valves & Actuators. Controls, ECU, etc..
 - Instrumentation
 - Turbopumps
 - Turbine Drive & Injectors (GG)
 - Main Combustion Chamber
 - Nozzle
- CLV US - MPS
 - LOX
 - LH2
 - MPS
- CLV US - Ullage Settling Motor
- CLV - RCS
 - ReCS
 - RoCS
- CLV Launch Abort System LAS
- PCAD Aerojet Ascent Main Engine
- CECE
- Pintle
- KSC – Launch Services - GFSSP Task
- Service Module
- Ares V RS68 study
- LSAM
- ILN



The Acronym



History of GFSSP

- Made an Official project in March of 1994
- First Version Released in October of 1997
- Version 3.0 Received NASA Software Award in 2001
- Conjugate Heat Transfer was introduced in version 5.0

Developers and Contributors of GFSSP

- GFSSP: Dr. Alok Majumdar*
- Ric Moore/MSFC *
- Katherine VanHooser/MSFC*
- Kimberly Holt/MSFC
- Paul Schallhorn/KSC
- Todd Steadman/MSFC*
- John Bailey/Jakobs
- VTASC: Saif Warsi/ERC

* Worked with or met on center

Amazing Abilities of GFSSP

- Multiple resistance options
- Numerous amount of fluids
- Calculates a variety of measurements
- Saves Money

(est. \$825,000 to \$1,545,900)

Dr. Alok NASA software of the year presentation

In 2001

Version 5.06 vs. Version 6.01

$$2042.64 \text{ seconds} * \frac{1 \text{ minute}}{60 \text{ seconds}} = 34.044 \text{ minutes}$$

Version 5.06

- Multiple S...
- Version 6.01
- Shortcut Bar

$$1026.14 \text{ seconds} * \frac{1 \text{ minute}}{60 \text{ seconds}} = 17.1023 \text{ minutes}$$

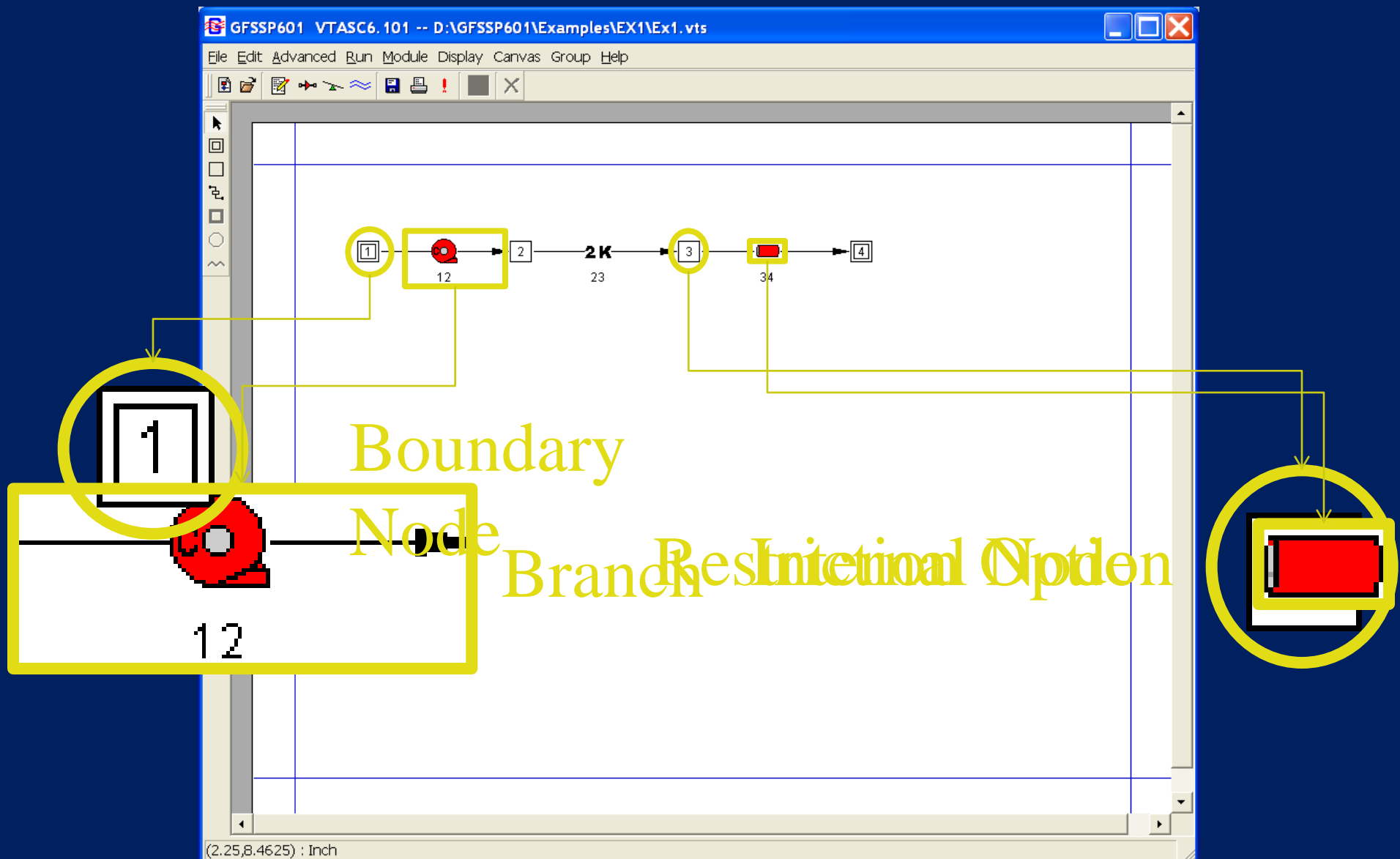
Table Example 12 Chosen Comparison Parameters

Chosen Testable Parameters	GFSSP V5.06	GFSSP V6.01 (N-S)	GFSSP V6.01 (B-S)	% ERROR V5.06/ 6.01 (N-S)	% ERROR V6.01 (N-S)/ 6.01(B-S)
Pressure (PSI) node 54 { final 60.02sec }	65.750	65.761	64.977	0.0167	1.1921
Temperature (°F) node 54 { 60.2 sec }	-95.767	-95.658	-266.765	0.1138	178.55
Pressure (PSI) node 29 { 200 sec }	51.361	51.356	49.035	0.0097	4.5194
Temperature (°F) node 29 { 200 sec }	80.627	80.627	77.044	0	4.4439
Flow Rate 1058 (LBM/Sec)	138.648	138.650	138.532	0.0014	0.0851
Flow Rate 1029 (LBM/Sec)	.084	.084	.087	0	35.714
Flow Rate 1033 (LBM/Sec)	64.106	64.105	63.976	.0014	0.0851
Flow Rate 1054 (LBM/Sec)	0	0	.371	0	UND.
Time Analysis (Sec)	2042.64	1026.14	720.50	-	-

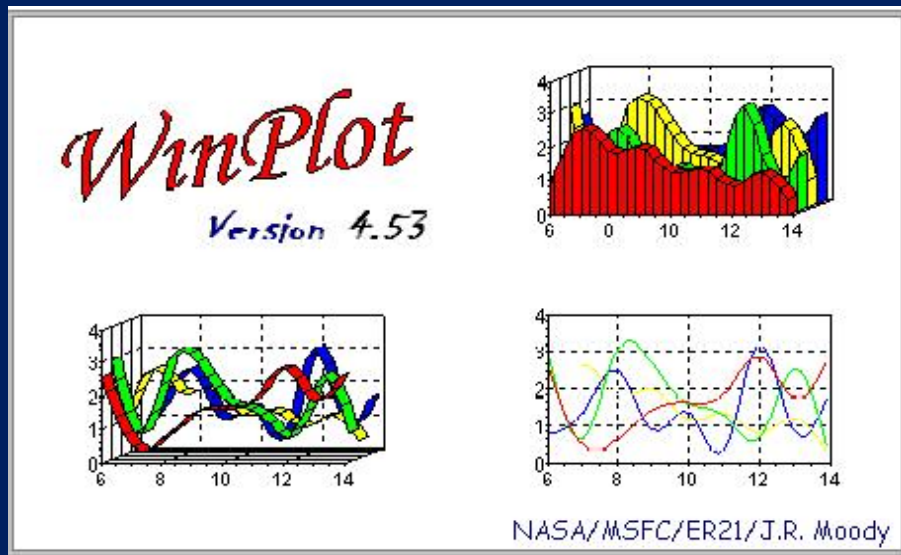
Future of GFSSP

- 2-D Models
- SI Units
- Synch with Patran/SINDA
- GFSSP still receives government funding for upgrades and improvements.

VTASC AT A GLANCE



WinPlot vs. Excel



WINPLOT V4.53	POST PROCESSORS	EXCEL 2007
★	DATA SPACE	
★	USER FRIENDLY	
★	ACCESSIBILITY	
	APPEAL	★

Validation Order

- PRE-PROCESSOR (VTASC)
- **PROCESSOR (GFSSP)**
- POST-PROCESSOR (WIN-PLOT)

GFSSP601

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ENTER INPU

GFSSP601 VTASC6.101 -- D:\GFSSP601\Examples\EX13\Ex13.vts

File Edit Advanced Run Module Display Canvas Group Help

(9.0375,3.175) : Inch

TIME	TS9	TIME	TS2
PS F	SECONDS	F	SECON
73.000	10	69.171	10
75.918	20	68.391	20
78.736	30	67.637	30
81.459	40	66.909	40
84.090	50	66.206	50
86.632	60	65.526	60
89.090	70	64.869	70
91.465	80	64.234	80
93.761	90	63.620	90
95.981	100	63.026	100

GFSSP Run Manager

Click here to stop simulation!

DIFK = 1.15912128298925 DIFD = 0.293134487721589

DIFH = 0.000000000000000E+000

ITER(RESISTANCE)= 5 ITER(NEWTON-RAPHSON)= 2

DIFK = 0.896173061021953 DIFD = 0.130148781565306 DIFH = 0.000000000000000E+000

DifMax Vs. Time

Edit Output Print Close

GFSSP outside of MSFC

- NASA

- ❖ARC
- ❖GSFC
- ❖JPL
- ❖KSC
- ❖LRC
- ❖GRC
- ❖DFRC

- Aero Space Corporation
- UAH/Computer Science Department
- Jacobs Engineering
- Los Alamos National Lab/ Applied Engineering Tech
- Barber-Nichols, Inc.
- UT-Battelle, LLC/Oak Ridge National Lab
- Jacobs Sverdrup
- Orion Propulsion Inc.
- Boeing Space & Information Systems
- Mechanical Solution Inc.

- Florida Turbine Technology
- Capstone Turbine Corp./Turbomachinery Div
- U.S. Army RDEcom
- Network Analysis Inc.
- Space Exploration Technologies Corp
- U.S. Air Force Research Lab/ Air Vehicles Directorate
- KT Engineering
- Schafer Corp.
- Alliant Techsystems, ATK GASL
- Air Force Research Lab/Liquid Rocket Engine Branch
- TGV Rockets
- United Launch Alliance
- SAIC-Huntsville, bdSystems Inc.
- QinetiQ North America
- Sierra Lobo, Inc.
- Air Launch LLC
- Bigelow Aerospace, LLC

Conclusion of Validation

GFSSP 6.01

- Saved significant run time
- V6.01 Newton Solver worked well
- V6.01 Broyden solver needs a few adjustments
- GFSSP will be a significant code regardless of the future program

Secondary Assignment

MSFC-ER 43 THERMAL ANALYSIS PEER REVIEW DATABASE

Yellow boxes are filled in by model report author. White boxes are to be filled out by the reviewer.

AIN Sample

Analysis Title: insert title here

Project Supported: insert project name here

Has the analysis been through the review process before? If so, indicate changes to the analysis since last review under OVERALL SUMMARY OF REVIEW section below.

Has an independent analysis (IA) been performed? If so, indicate type of analysis and by whom? Write results of independent analysis in the OVERALL SUMMARY OF REVIEW section below.

Location of Model S

Location of Report S

Report No

Model A

Review

Review

Type of review performed

Brief Description of model (write Type a short description of the model requirements, then an LCC Sim, a

Linearly Elastic / Nonlinear

Model Type: Thermal / Mechanical

Dimensionality: 2D / 3D

Name

Pre Processor: Pre P

Post Processor: Post P

Analysis Code: Code-S

Analysis Code: Code-S

Analysis Code: Code-C

Analysis Code: Code-T

1 Geometry

1-1 Check that drawing versions used for model are documented within report or model

1-2 Check that model captures required physics and that simplifications were justified

R0 Verified

Comments

Archived Comments

43 Analysis Form (Prototype)

1 Geometry

1-1 Check that drawing versions used for model are documented within report or model

1-2 Check that model captures required physics and that simplifications were justified

R0 Verified

Comments

Archived Comments

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1-2 R0 Verific

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Third Assignment

- PATRAN/SINDA
(NASTRAN)
- Completed examples
- Recognized capabilities

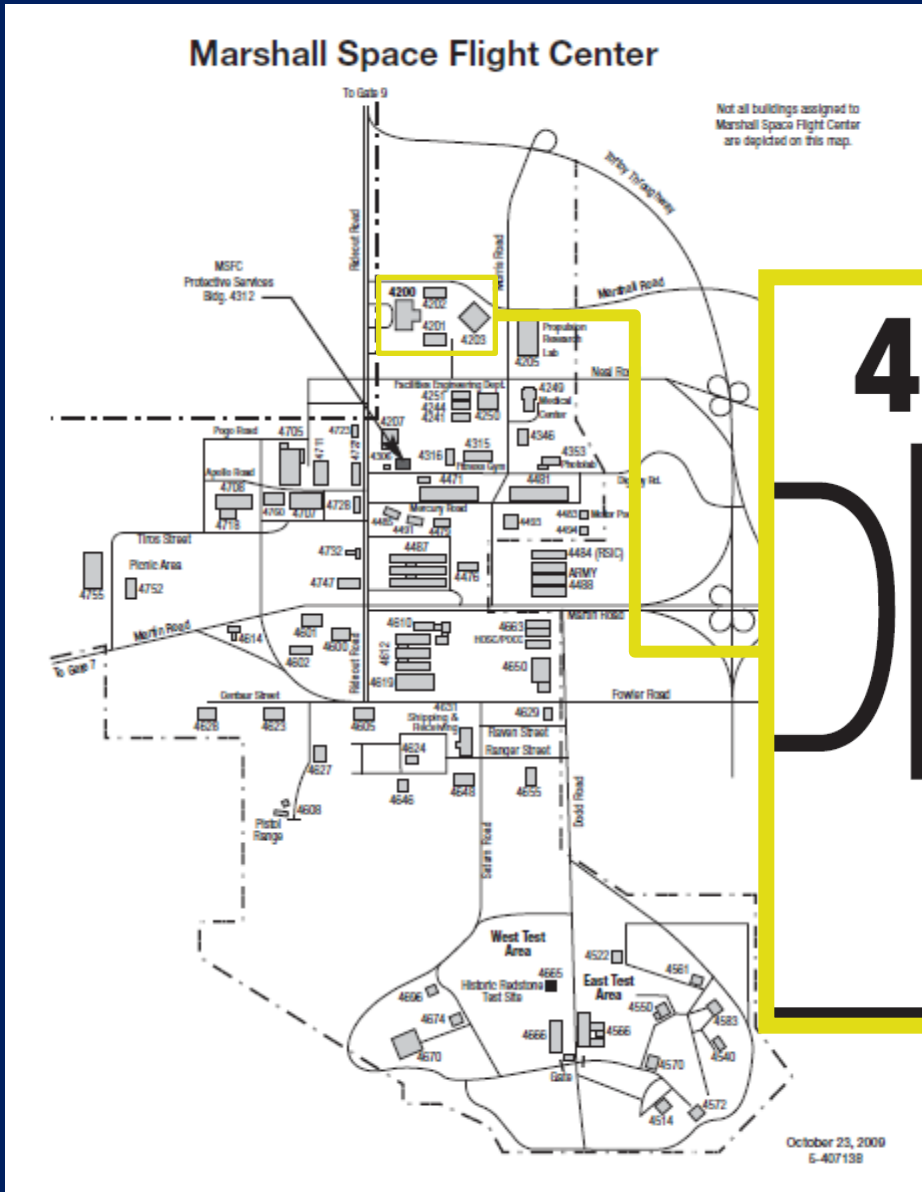
New **Skills** Acquired

- GFSSP V5.06 (with VTASC)
- GFSSP V6.01 (with VTASC)
- PATRAN 2008/SINDA
- WinPlot V4.53
- Microsoft Access
- Working in a Cubicle
- Networking Improved

Work Space

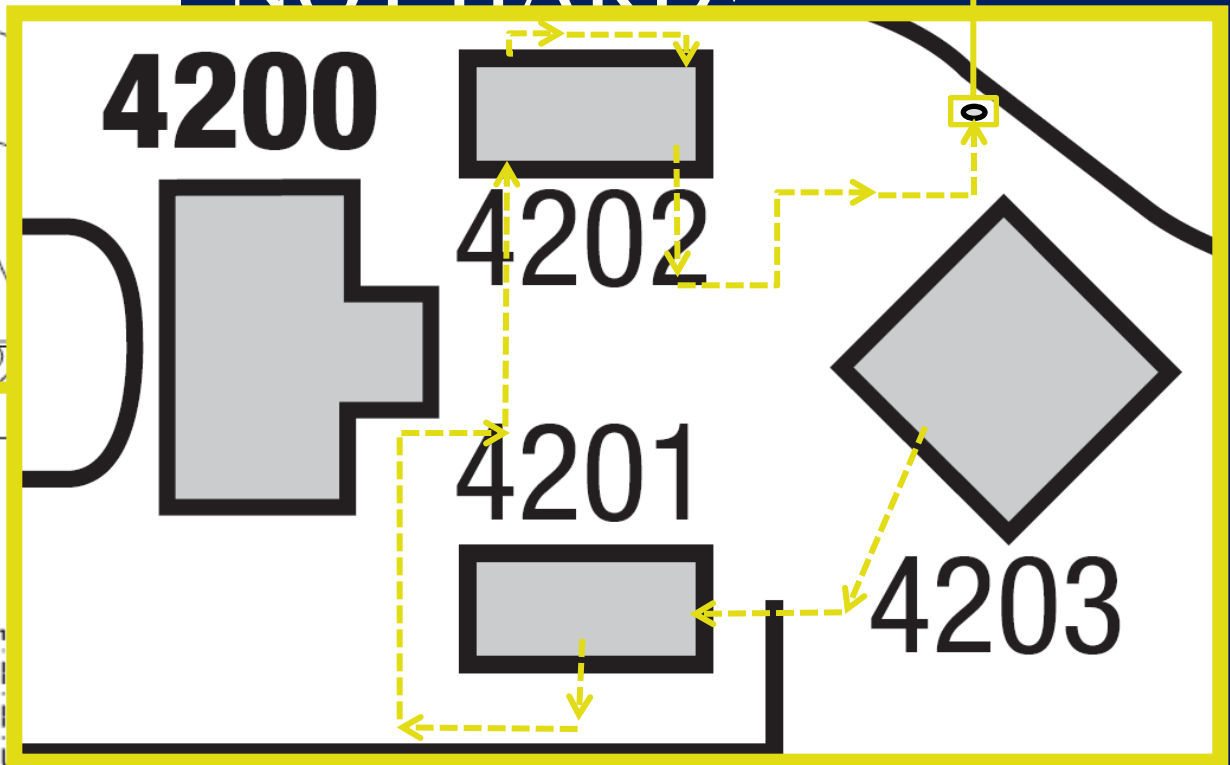


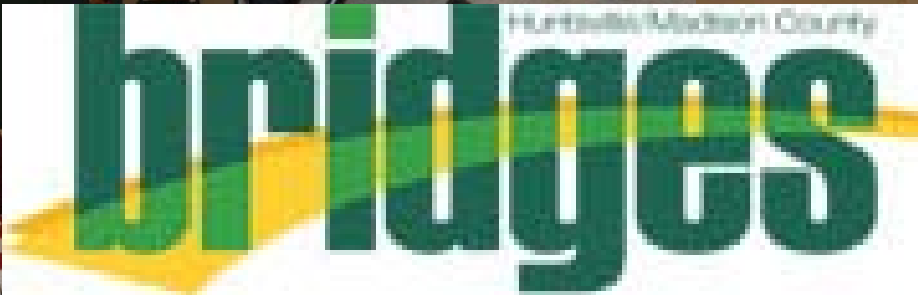
Lessons Learned



amount of acronyms
NOT HARD!

My Car...











SPECIAL THANKS

Ms. Melissa Van Dyke

Ms. Mona Miller

Ms. Carla Holloway

Dr. Alok Majumdar

Mr. Stan Tieman

Mr. Odric Moore

Mr. Michael Radden

Mr. Joe Ruf

Mr. Chris Morris

Mr. Graham Nelson

Mr. Marvin Rocker

Ms. Chrissa Hall

Mr. Uttam Gill

Ms. Shawanda Maynard

Mr. Mathew Cross

Ms. Brenda Polk

Mr. Ed Reske

Mr. Andre Leclair

Ms. Catherine Ladd

Mr. Javiher Hogan

Ms. Karla Miller

Bridges Huntsville/ Madison County

Ms. Peggye Thibodeaux

MSFC Interns and Co-ops of Spring 2010

[All TOUR GUIDES] during the internship

ALL Users of GFSSP

Anyone who has shared encouraging

words to me in the gym,

parking lot, elevator, or anywhere else while on Center

ER 43: Thermal & Combustion Analysis Team

Ms. Tina Haymaker

Alabama Agricultural and Mechanical University

Mr. Darrell Gaddy

Ms. Robyn Jackson

Ms. Eloise Gardner

Mr. Oren Kornberg

Mr. Louie Clayton

Mr. Chris Morris

Mr. Brian Goode

Ms. Katherine Van Hooser

Mr. Chris Randall

Mr. Johnathan Darden

Mr. Gregory Fraddy

Mr. Robert Orso

Mr. Hee Jong Song

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Mr. Shane Lackey

Ms. Becky Hopson

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Image & Information Acknowledgement Page

Memphis image:

http://arachnerd.files.wordpress.com/2009/04/memphis-tennessee-us_01-360a030707.jpg

Alabama A&M University:

<http://www.alabamabowling.com/aamu/aamu.gif>

ER-43 Information and Imagery: Melissa Van Dyke, Darryl Gaddy, Louie Clayton, and ER-43

GFSSP & VTASC imagery VTASC: Dr. Alok Majumdar, Mr. Saif Warsi, and other GFSSP developers and contributors

Winplot icon: J.R. Moody

GFSSP website

<http://gfssp.msfc.nasa.gov/>

